Profitable Dairy Cow Traits for Future Production Circumstances

Albert de Vries, Ph.D.

Department of Animal Sciences
University of Florida
Gainesville, Florida, USA

UF | UNIVERSITY of FLORIDA
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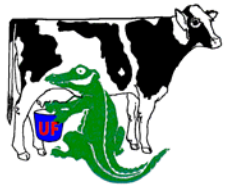
Florida

2006

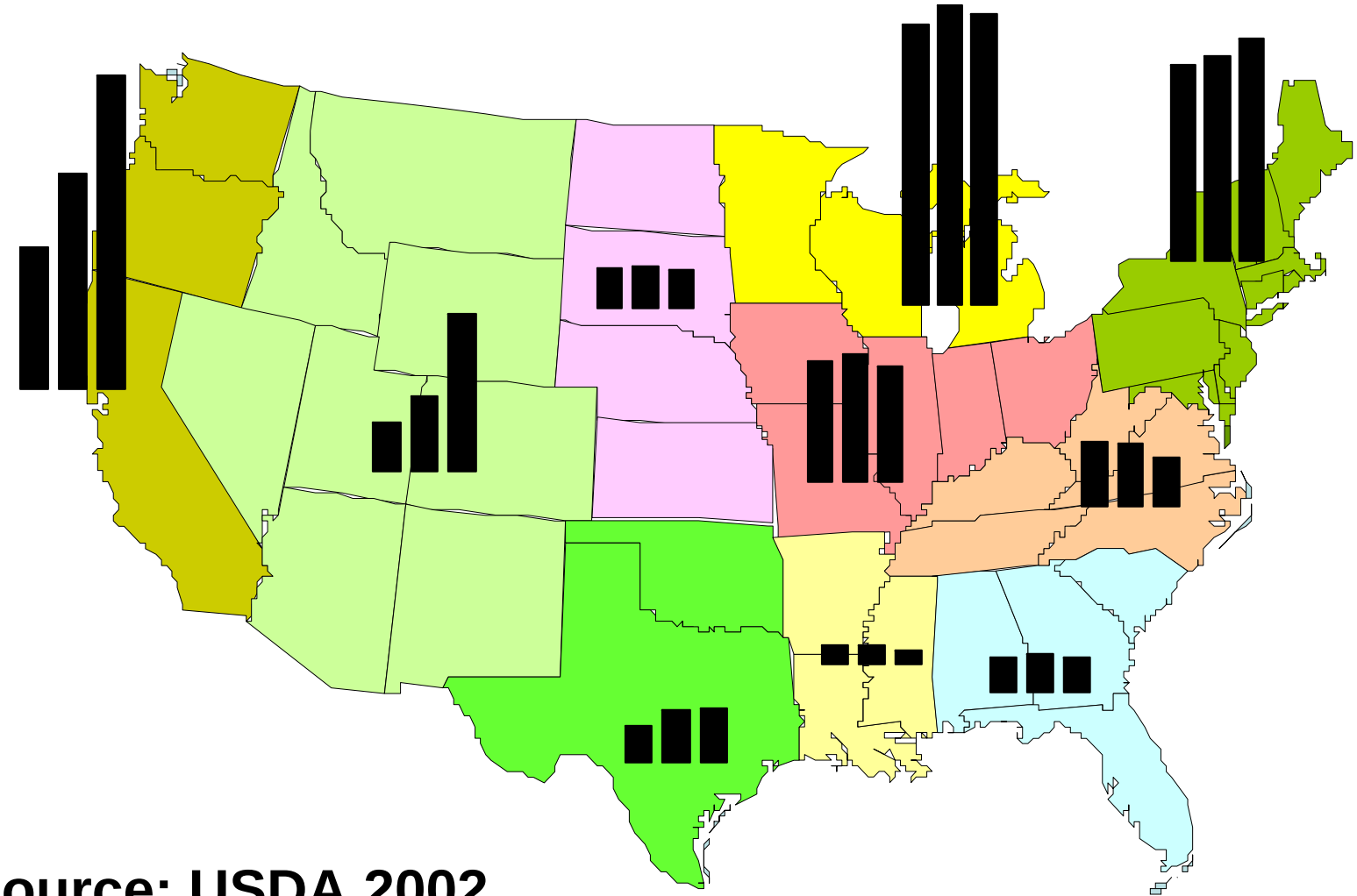
- 18 million people
- 152,000 km^2 (20% area of Turkey)
- Major industries: tourism, agriculture
- 131,000 dairy cows
- 170 dairy farms (771 dairy cows / farm)
- 19th in USA based on total milk production
- 90% of milk used for fluid consumption



Outline

- American dairy production systems
- Economic values of dairy cow traits
  - Milk
  - Productive life
  - Reproduction
  - Other traits
- Summary

Milk Production
1980, 1990, 2000



Source: USDA 2002

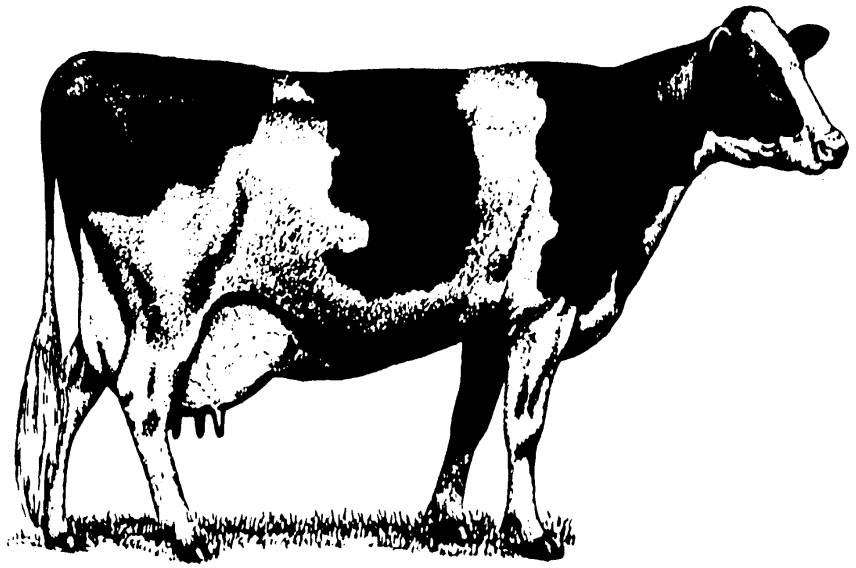

Milk

Trends in American Dairy Farming

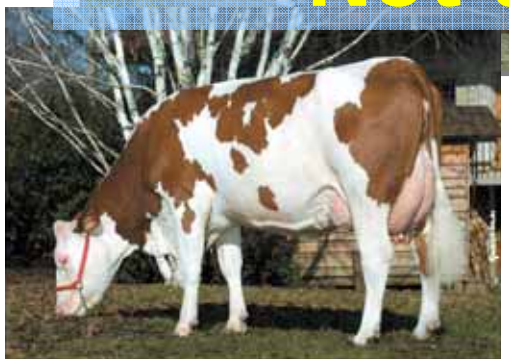
- Increasing herd sizes
  - 100s to 10,000s of cows
  - Dairy farming is a business
- Away from population centers
  - Lower real estate prices
  - Less environmental pressure
  - Availability of quality, cheap forages
- Specialized
  - Milking cows (may be raise heifers, crops)
- Management
  - Hired labor (mostly Hispanic)
  - High energy total-mixed rations
  - Freestalls, dry lots, some pasture

Which Cow Serves These Farmers Best?

- Dairy producers want a cow with high production during a long, trouble-free life



Not all dairy cows are alike



Sources: H.D. Normand, L.B. Hansen, Google

Net Merit as a Measure of Lifetime Profit

USDA August 2006 revision

- Selection index is a combination of predicted transmitting abilities (PTAs) and their economic values
- Best known selection index in US is Net Merit (NM$)
  - *Goal: breed the most economical cow*
- Calculated by USDA for bulls and cows, 4x per year
- Traits in NM$ index (2006):

1) Protein	6) Udder
2) Fat	7) Feed and legs
3) Milk (volume)	8) Body size
4) Productive life	9) Daughter pregnancy rate
5) Somatic cell score	10) Calving ability index

VanRaden et al. (2006) http://aipl.arsusda.gov/reference/nmcalc.htm

Net Merit Economic Values (2006)

Lifetime values

Trait	Units	Standard deviation (SD)	Value ($/PTA unit)	Relative value (%)
Protein	Pounds/305d	22	**3.55**	23
Fat	Pounds/305d	30	**2.70**	23
Milk (volume)	Pounds/305d	780	**0**	0
Productive life	Months	2.1	**29**	17
Somatic cell score	Log	0.20	**-150**	-9
Udder	Composite	0.78	**28**	6
Feet and legs	Composite	0.88	**13**	3
Body size	Composite	0.94	**-14**	-4
Daughter pregnancy rate	Percent	1.4	**21**	9
Calving ability	Dollars	20	**1**	6
				100

Relative value = SD x Value($/PTA unit) / Σ {SD x Value($/PTA unit)}

Relative Economic Values for Selected US Selection Indexes

Trait	Selection index Year introduced	MF$ 1971	MFP$ 1976	NM$ 1994	NM$ 2000	NM$ 2003	NM$ 2006
Milk		52	27	6	5	0	0
Fat		48	46	25	21	22	23
Protein			27	43	36	33	23
Productive life				20	14	11	17
Somatic cell score				-6	-9	-9	-9
Daughter pregnancy rate						7	9
Service sire calving ease						-2	
Daughter calving ease						-2	
Calving ability							6
Udder					7	7	6
Feet and legs					4	4	3
Body size					-4	-3	-4

Shook. J Dairy Sci 89:1349 (2006)

US Milk Pricing

- Net Merit assumes farmers receive $1.50 per pound of fat, $1.95 per pound of protein, and $0.016 per pound of milk volume.
- But real milk pricing in the US depends on the market:
  - Wisconsin: cheese production (protein)
  - Florida: fluid milk consumption (volume, fat)
- USDA calculates 3 merit indices
  - Farmers should select bulls and cows based on their market

Index	Fat / lbs	Protein / lbs	Volume / lbs
Net Merit $	$1.50	$1.95	$0.016
Cheese Merit $	$1.50	$2.80	-$0.010
Fluid Merit $	$1.50	$0.57	$0.057

Milk Quota

- Milk quota = output limitation at the farm level

	Value of Trait (Dfl/unit/cow/year)			
Limitation	Volume	Fat	Protein	Beef
Without quota	-0.13	7.97	11.27	-0.92
Quota	-0.33	7.75	11.04	-0.92
Change in value	-154%	-3%	-2%	0%

- Best cow produces fat + protein, but no volume

Groen. Livest Prod Sci 22:17 (1989)

Somatic Cell Count (SCC)

- Measure of mastitis
- Legal maximum
  - US: 750,000 cells/ml
  - EU: 400,000 cells/ml
- Value of lowering SCC:
  - Reduces labor, discarded milk, antibiotics, other health cost associated with mastitis (Net Merit $: 28% of value of SCC)
  - Most US markets have bonus for lower SCC (NM$: 72% of value)
  - Florida: no bonus/penalty < 750,000 SCC (fluid milk market)

➡ Value of reducing SCC in milk depends on milk pricing

Productive Life

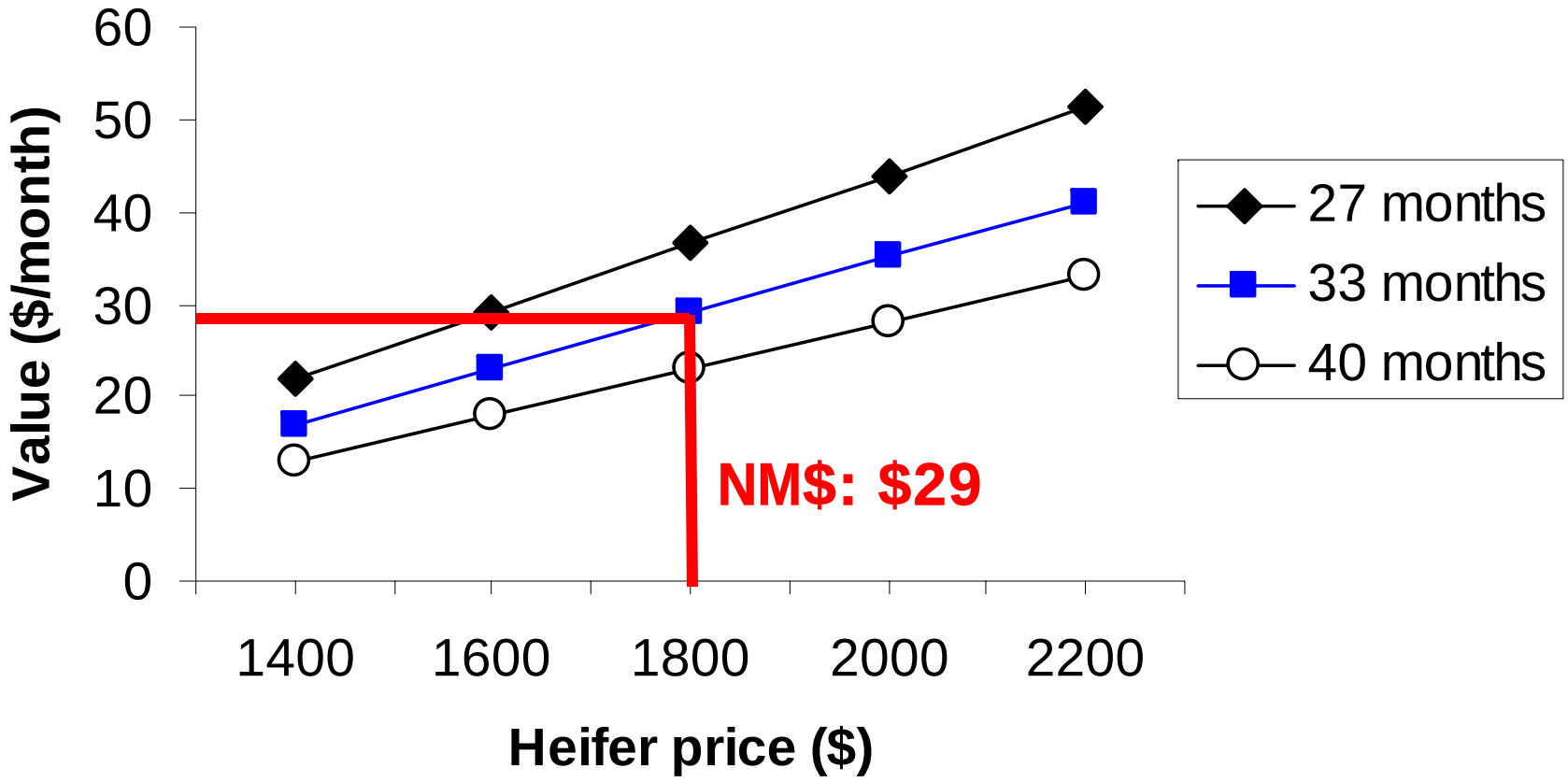
- Productive life = time cows spend in the milking herd before removal by culling or death.
  - Synonyms: longevity, herd life
  - US ≈ 33 months (2.8 years)

- Value productive life (in months):

$$\text{Net Merit \$ value} \approx \frac{\text{Heifer price – cull price}}{\text{Productive life (in months)}}$$

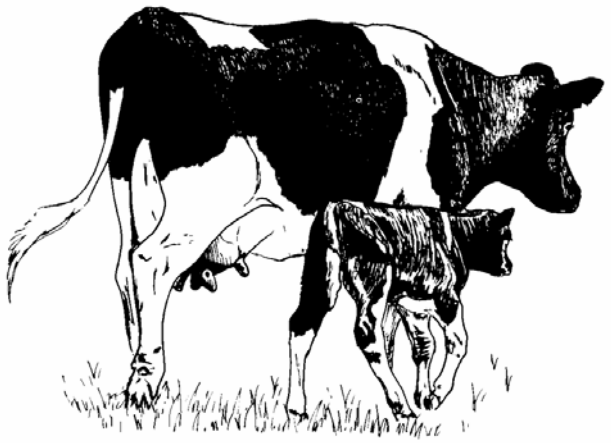
  - NM$ 2006: heifer price = $1800, cull price = $678
  - $29 (NM$ 2006), $26 (NM$ 2003), $28 (NM$ 2000)

Value of Productive Life



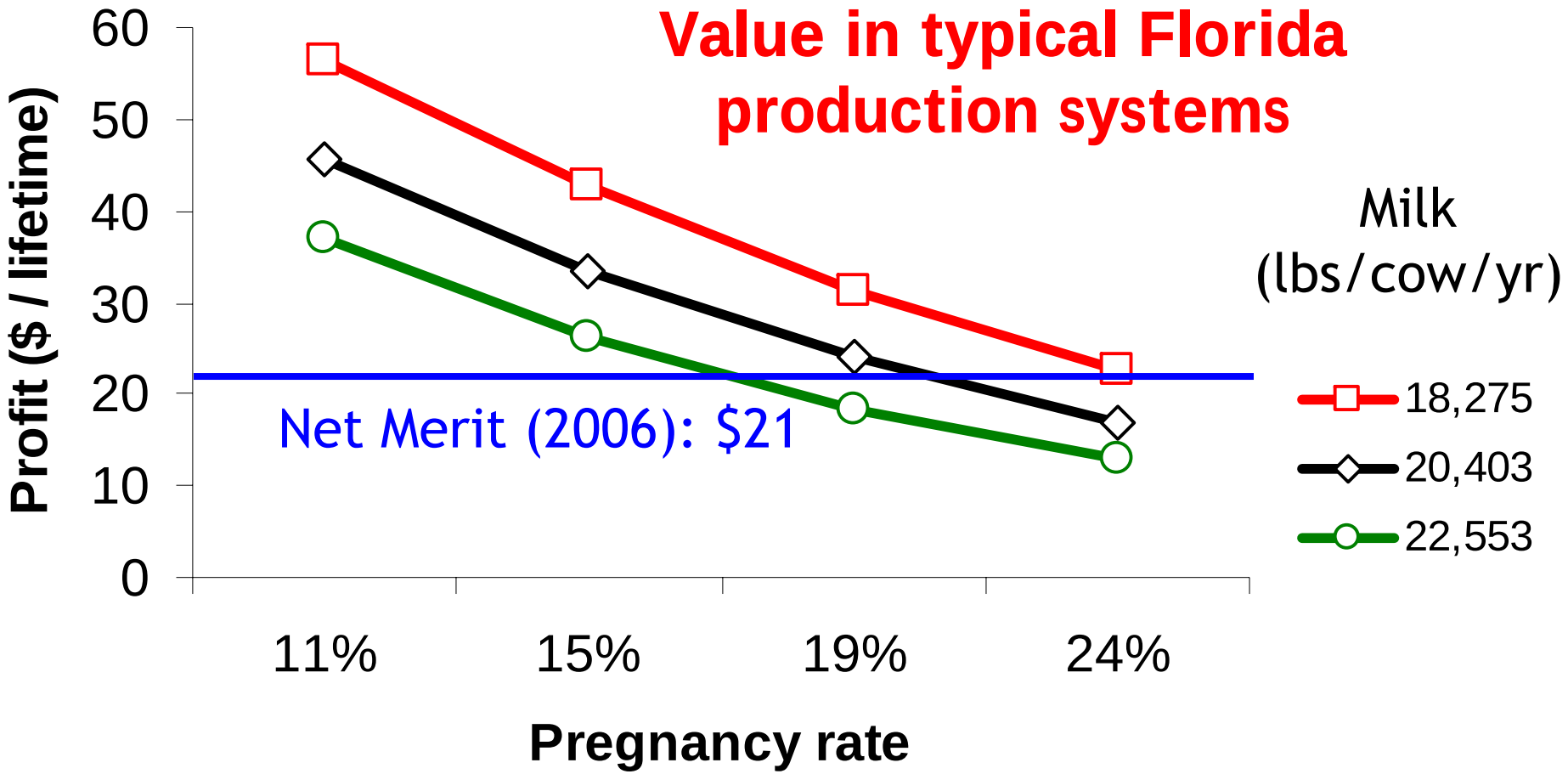
Daughter Pregnancy Rate

- **Daughter Pregnancy Rate (DPR) is defined as the percentage of nonpregnant cows that become pregnant during each 21-day period.**
  - Key measure of reproductive efficiency in US.
  - Pregnancy rate on US farms ≈ 12% to 25%.
  - Each increase of 1 DPR equals a decrease of 4 days in days not pregnant (days open).



Value of Pregnancy Rate

1 percentage point change



Value of Reproduction in Seasonal Pasture-based Systems

- Fertility more important
  - Less opportunity to get cows pregnant
- 1% increase in fertility in Australia (InCalf):
  - Year-round calving herds: $2.05
  - Seasonal calving herds: $5.90
- *Compared to US Holsteins,* New Zealand Holstein-Friesians had better fertility, lower body weight, less milk volume, less protein yield, higher fat% and protein%, and better survival
  (Harris and Kolver, 2001)

Udder Conformation

- Net Merit $ udder composite = *f* (fore udder, rear udder height, rear udder width, udder cleft, udder depth, teat placement, teat length)
- Udder conformation more important in Voluntary milking systems (robot)

Body Size

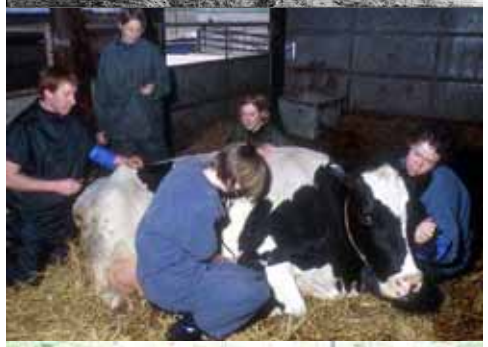
- Net Merit $ body size = *f*(stature, strength, body depth, rump width)
- Smaller cows preferred:
  - More feed efficient (less maintenance)
  - Improved fertility, productive life, calving ability

Feet and Legs

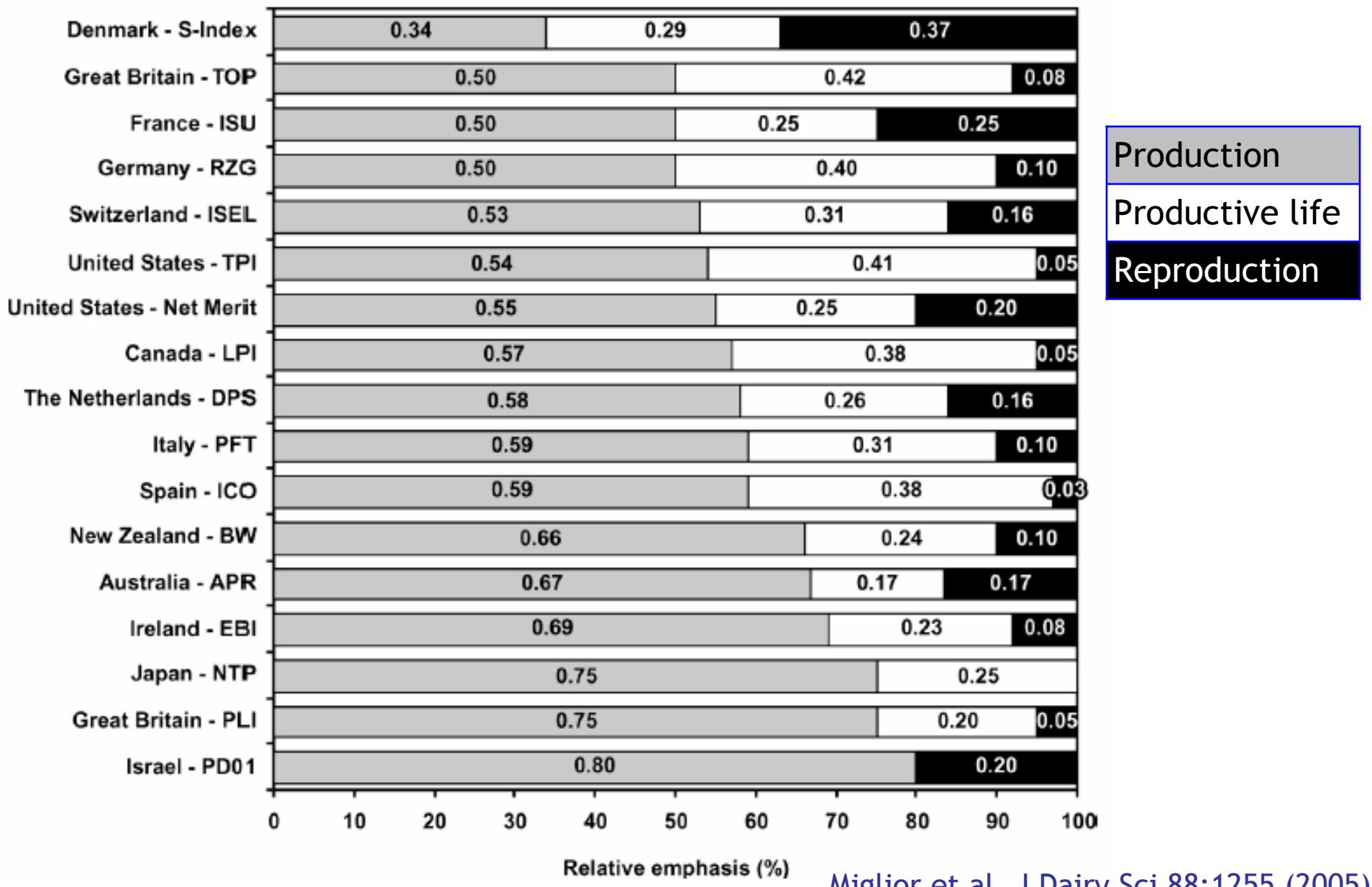
- Net Merit $ feet/legs composite = *f*(rear legs side view, rear legs rear view, foot angle, feed and legs score)
- Feet/leg conformation more important when parlor capacity is limited
  - Parlors used 24/7, slow cows reduce milk/parlor stall/hour

Some Other Traits of Economic Importance

- Calving Ease and Stillbirth
  - Included in Net Merit (2006)
- Feed efficiency
  - More important when forage availability is limited
  - Reduce excretion of N, P, K, CH_4?
- Metabolic disease resistance
  - Limited availability of health data in the US
- Heat resistance
  - Heat tolerance breeding value
  - Slick hair gene



Relative Emphasis in Selection Indices (2003)



Miglior et al. J Dairy Sci 88:1255 (2005)

Crossbreeding?

Pictures: L. B. Hansen, University of Minnesota

Summary

- Economic values of changes in dairy cattle traits differ greatly among farms.
  - Prices
  - Environmental conditions
  - Facilities/equipment

- Customized (selection) indices allow for modification of economic values for specific farm conditions. Cows that score high on such indices would serve that farmer best.


Thank you
Albert de Vries
devries@ufl.edu
http://www.animal.ufl.edu/devries